Pergamon

Tetrahedron Letters 40 (1999) 4493–4496

TETRAHEDRON LETTERS

Unusual C-C Cleavage During Reduction of a β-Aminonitroalkene[1]

Jeremiah P. Freeman[a], Lloyd Laurian[b] and Jacob Szmuszkovicz[a,b]

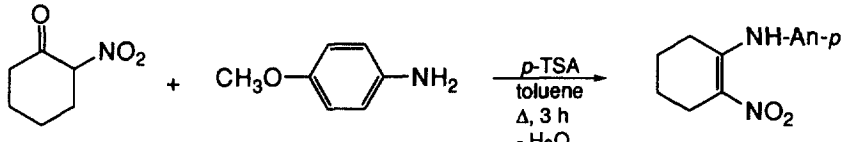
[a]Department of Chemistry and Biochemistry, University of Notre Dame, Notre Dame, Indiana 46566
[b]The Upjohn Company, Kalamazoo, Michigan 49001

Received 22 February 1999; revised 15 April 1999; accepted 16 April 1999

Abstract: An unusual ring cleavage product **3**, a diamine, was observed during LAH reduction of β-aminonitroalkene **1**.

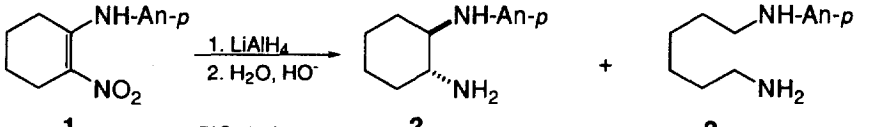
Due to our long-standing interest in the diastereospecific formation of 1,2-diamines[2], we briefly examined the reduction of β-aminonitroalkenes (nitroenamines)[3], previously suggested[3] as a potential route to such compounds. While this method did not prove to be efficient in the cases we examined, due to side reactions, we did observe one unusual reduction mode.

β-Aminonitroalkene **1** was prepared by condensation of *p*-anisidine with 2-nitrocyclohexanone[4]. Reduction of **1** with lithium aluminum hydride yielded two products: trans-diamine **2**



1
mp 123-124°C (93% yield)

and the ring-cleavage product **3**. The structure of diamine **3** is based on its mass spectrum (M+222) and its NMR spectrum.



1
mp 123-124°C

95°C, 24 h
21% yield

2
2·2 HCl: mp 247-248°C
(9% yield)

3
3· 2 HCl: mp 213-214°C
(12% yield)

We propose the reaction path shown in the Scheme for the transformation of **1** to **3**. Compound **1** undergoes conjugate reduction with LAH to the dihydro compound **1b**. A reverse aldol reaction brings about ring cleavage to **1c**, which is reduced by LAH to the observed product **3**.

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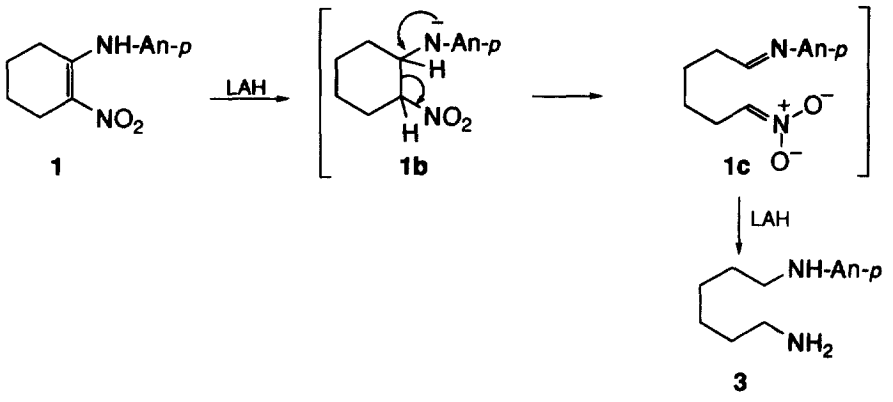
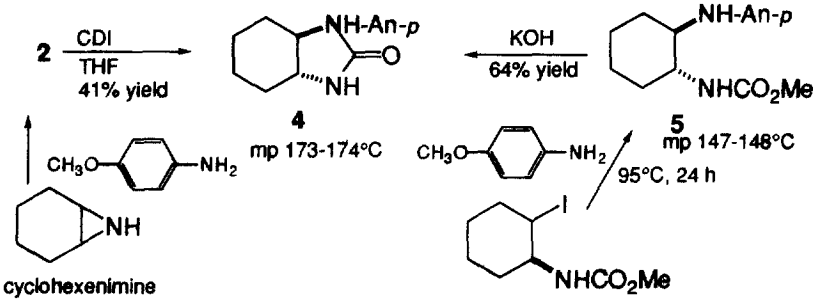
PII: S0040-4039(99)00818-7

Scheme

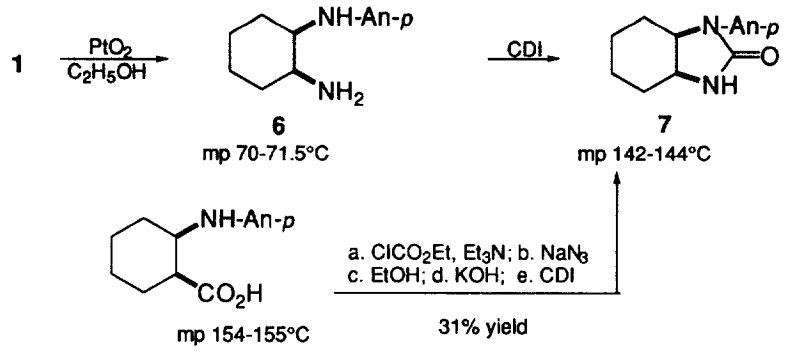


The stereochemistry of **2** was established by conversion to the corresponding imidazolidinone **4**, which was identical to that prepared from trans-1-(*N*-*p*-anisyl)-2-(*N*-carbomethoxy)cyclohexanediamine **5** by base-catalyzed ring closure. The diamine derivative **5** in

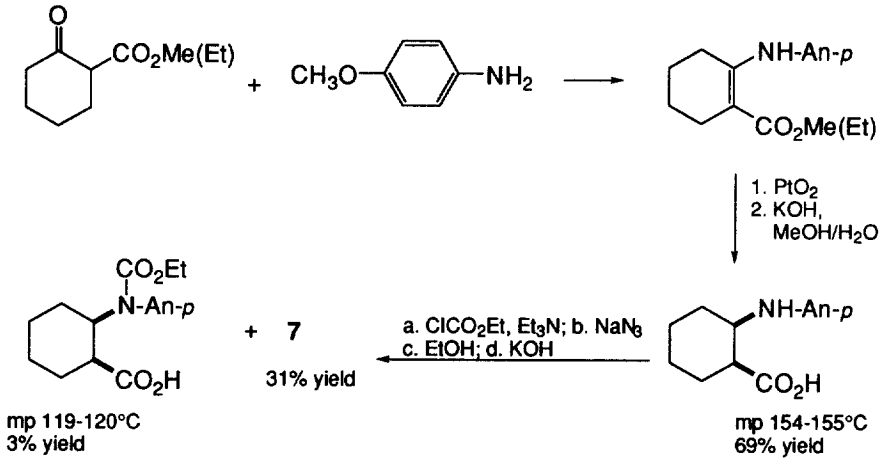


turn was prepared by the action of *p*-anisidine on methyl *N*-(trans-2-iodocyclohexyl)carbamate[5]. Diamine **2** could also be prepared in 21% yield by the action of *p*-anisidine on cyclohexenimine.

Catalytic reduction of **1** over platinum oxide produced cis-1-(*N*-*p*-anisyl)-2-cyclohexanediamine **6** in only an 8% yield along with p-anisidine in 48% yield. The stereochemistry of **6** was



consistent with its NMR spectrum[6] and was established by conversion with carbonyldiimidazole to an imidazolidinone derivative **7**,[7] which was identical to that prepared independently from cis-2-(*p*-anisidino)-cyclohexanecarboxylic acid by the following steps:



Other nitroenamines analogous to **1** (*N*-phenyl and *N*-*p*-chlorophenyl) were subjected to catalytic reduction but only hydrogenolysis products could be identified. In particular no ring cleavage products were detected. LAH reductions were not examined.

References and Notes

1. The work described here was performed at the Upjohn Company (J.S. is now at the University of Notre Dame.)
2. Freeman, J.P.; Michalson, E.T.; D'Andrea, S.V.; Baczynskyj, L.; VonVoightlander, P.F.; Lahti, R.A.; Smith, M.W.; Lawson, C.F.; Scahill, T.A.; Miszak, S.A.; Szmuszkovicz, J. *J. Med. Chem.* **1991**, *34*, 1891. D'Andrea, S.V.; Freeman, J.P.; VonVoightlander, P.F.; Szmuszkovicz, J. *Tetrahedron*, **1991**, *47*, 6157.
3. Rajappa, S. *Tetrahedron*, **1981**, *37*, 1453.
4. Griswold, A.A.; Starcher, P.S. *J. Org. Chem.* **1966**, *31*, 357.
5. Swift, G.; Swern, D. *J. Org. Chem.* **1967**, *72*, 511.
6. Data for compound **6**: mp 70-71.5°C (ether). UV (EtOH): λ_{max} 245.5 nm (11,850); 309.5 (2050). IR (nujol, cm^{-1}): 3360, 3260, 3180, 3100, 3030, 1620 w, 1575, 1535, 1510, 1260, 1250, 1240, 1180, 1035, 825. ^1H NMR ($CDCl_3$) δ 1.2-1.8 (8 H, m), 1.1-2.2 (3 H, m, exch.), 3.0-3.5 (2 H, m), 3.72 (3 H, s), 6.62 (2 H, AA', m), 6.77 (2 H, BB', m). Anal. Calcd for $C_{13}H_{20}N_2O$: C, 70.87; H, 9.15; N, 12.72. Found: C, 70.97; H, 9.24; N, 12.93. In a separate experiment a polymorph of compound **6** was isolated by virtue of its insolubility in ether. It melted at 106-110° and was identical by UV, IR and NMR to the compound described above.
7. Data for compound **7**: mp 142-144°C (ether). UV (EtOH): λ_{max} 242 nm (11,800); sh 275 (1390); 280 (1500). IR (nujol, cm^{-1}): 3190, 3100, 3080, 1695, 1615, 1580, 1510, 1295, 1250, 1240, 1180, 1140, 1045, 855. ^1H NMR ($CDCl_3$) δ 1.12-1.9 (8 H, m), 3.72 (1 H, m), 4.08 (1 H, dt, J = 6, 5, 5 Hz), 3.8 (3 H, s), 5.54 (1 H, NH, s), 6.90 (2 H, m, AA'), 7.30 (2 H, m, BB'). Anal. Calcd for $C_{14}H_{18}N_2O_2$: C, 68.27; H, 7.37; N, 11.37. Found: C, 68.54; H, 7.39; N, 11.23.